



An Analysis of the Effect of Salinity on Dissolved Oxygen in a Pond and its Impact on Pisciculture

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Abstract— This study examines the influence of salinity on dissolved oxygen (DO) in pond ecosystems and evaluates its consequences for pisciculture. Dissolved oxygen is one of the most important indicators of water quality because it directly affects fish metabolism, growth, reproduction, immunity, and survival. Salinity alters the physical and chemical properties of water and consequently affects oxygen solubility. Sample observations demonstrated a progressive decline in dissolved oxygen concentration from 8.5 mg/L to 5.9 mg/L as salinity increased from 0 to 12 ppt. The results suggest a strong negative relationship between salinity and dissolved oxygen. Such reductions can adversely affect pond productivity and fish yield. Effective monitoring and management of salinity and oxygen levels are therefore essential for sustainable aquaculture.



Keywords— Salinity, Dissolved Oxygen, Pond Ecosystem, Pisciculture.

I. INTRODUCTION

Pisciculture is an important component of global food security and rural livelihoods. Successful fish culture depends on maintaining suitable water quality conditions. Among the various parameters, dissolved oxygen is considered one of the most critical factors because fish and other aquatic organisms rely on it for respiration. Salinity, defined as the concentration of dissolved salts in water, can significantly influence oxygen availability. Salinity and dissolved oxygen (DO) are two important water quality parameters that directly influence aquatic ecosystems and fish production. This article analyses the relationship between salinity and dissolved oxygen in pond ecosystems and evaluates its implications for pisciculture. Increasing salinity alters the physical and chemical properties of water, affecting oxygen solubility, fish metabolism, microbial activity, and pond productivity. A review of scientific literature indicates that higher salinity generally reduces oxygen solubility, increasing the risk of oxygen stress in cultured fish. Understanding these interactions is essential for effective pond management, especially in regions facing salinisation due to climate change, irrigation practices, and groundwater intrusion. The study discusses mechanisms, impacts on fish growth and survival, and management strategies for sustainable

aquaculture. Many freshwater ponds experience salinity fluctuations due to evaporation, agricultural runoff, groundwater seepage, and climate-related changes. Understanding the relationship between salinity and dissolved oxygen is therefore important for optimising fish production and maintaining pond health. Dissolved oxygen refers to the amount of free oxygen present in water. Oxygen enters ponds through atmospheric diffusion, photosynthesis by aquatic plants, and mechanical aeration. Salinity influences oxygen solubility because dissolved salts reduce the capacity of water to hold oxygen molecules. As salinity increases, oxygen solubility decreases. Temperature further modifies this relationship, with warm saline water holding considerably less oxygen than cool freshwater. Salt affected soils are important ecological entity as it is known that land occupying 6% of the global land area and 2.6% of the geographical area in India, Indo-Gangetic Plain (IGP), which is the most fertile agricultural region in India also has around 3.095 million ha land is salt affected areas of which 12% exist in Bihar (Mandal and Sharma, 2006). Utilisation of these salt affected areas for productive purpose is the major challenge for the region. In this regard, inland saline aquaculture provides an opportunity for the diversification and expansion of agriculture through

a potentially productive use of land that can no longer support standard agricultural enterprises (McDowall et al., 2016). Thus, aquaculture can be an adaptive approach to this environmental problem and can represent a potentially lucrative use for salt-affected land, with many economic, social and environmental benefits (Lymbery et al., 2007). However, selection of suitable fish species having tolerance to saline conditions is very important before venturing into aquaculture in these areas. This is mainly because higher salinity of water can act as an important stressor under natural as well as aquaculture conditions (Islam et al., 2014) and water quality can directly influence the metabolism of fish, which ultimately affects the survival, growth, feed intake and even distribution of species (Garg, 1996 ; Kang'ombe and Brown, 2008; Akhtar et al., 2013).

Fish require adequate oxygen for metabolism and digestion. Reduced DO levels lower feeding activity and growth rates. Chronic oxygen deficiency causes physiological stress, weakens immune responses, and increases vulnerability to pathogens. The reduction in dissolved oxygen occurs because salt ions occupy space among water molecules, decreasing the availability of sites where oxygen can dissolve. Consequently, ponds with elevated salinity often exhibit lower dissolved oxygen concentrations than freshwater ponds under similar environmental conditions.

Pisciculture plays a crucial role in food security, nutrition, employment generation and rural development. . Dissolved oxygen, often abbreviated as DO, is the amount of free oxygen molecules (O_2) dissolved in water. Oxygen enters the water through atmospheric diffusion, plant photosynthesis, or aeration (either natural or man-made). DO is typically represented in measurement units as percent of air saturation (%sat) and concentration in milligrams per liter (mg/L) or parts per million (ppm).

Dissolved oxygen levels measured at 3 mg/L are in the danger zone for supporting common aquatic life, and levels below 1 mg/L cannot support any aquatic life. When dissolved oxygen level decreased because of salinity increases, water conditions soon become lethal for aquatic life. So, increasing the salt concentration will lead to a decrease in oxygen solubility, negatively affecting any aquatic life inside water. So the available parameters of dissolved oxygen for sustainability of life in fresh water is very vital for pisciculture practices.

II. MATERIALS AND METHODS

A pond-based investigation was conducted by collecting water samples from multiple locations and depths. Salinity was measured using a digital salinity meter while dissolved oxygen was determined using a DO meter . Measurements were taken during morning and afternoon periods over several weeks during January to March from a fresh water pond located in Darbhanga city under the campus of M. K. College , Laheriasarai . After observation of recorded data of salinity and DO with the help of table and graph, finding was analysed using the comparative variations between salinity and dissolved oxygen in pond water. Its impact on pisciculture was also discussed with the help present result.

III. RESULT AND DISCUSSION

The results indicated a consistent decline in dissolved oxygen with increasing salinity as shown in the table 1 . This pattern agrees with the established understanding that dissolved salts reduce oxygen solubility in water. The observed inverse relationship between salinity and dissolved oxygen has important ecological and aquacultural implications. Reduced oxygen availability can impair fish health, growth and survival. Severe oxygen depletion can result in mass fish mortality, particularly during warm weather or algal bloom collapses. Some species such as *Tilapia* tolerate moderate salinity, whereas many freshwater carps like *Labeo* species perform best under low salinity conditions. Oxygen stress combined with salinity stress can further reduce productivity. Poor oxygen conditions negatively affect spawning, egg development, and larval survival.

Effect of salinity alone on rate of oxygen consumption of freshwater species negatively affect their physiological cycle. Zheng et al. (2008) recorded lower oxygen consumption rate at 31‰ compared to 16‰ on *Müichthys miiuy*. While in another study on oxygen consumption rate of *Dicentrarchus labrax* fingerlings, only slight variation was recorded between 3 and 45 percent which was attributed to strong euryhaline nature of the species (Barnabe, 1990; Dalla et al., 1998). The alterations in oxygen consumption in fishes at different salinities could be due to differences in energy required for osmoregulation or from changes in the spontaneous activity level of fish and changes in the routine metabolic rate (De Boeck et al., 2000). The study has showed that oxygen consumption rate was lowest at 4.5 percent which could be attributed to energy conservation strategy adopted by the species to salinity mediated stress (De Boeck et al., 2000). In the view of management strategy of pond regular monitoring of salinity, temperature and dissolved oxygen should be performed. Aeration, appropriate

stocking density, periodic water exchange and proper feeding practices can reduce stress on cultured fishes.

As an ecological factor, ambient salinity has a series of physiological effects on fish. As reported in previous studies, salinity is an important factor regulating fish growth, metabolism, and various physiological activities (Katz et al., 2001). Ambient salinity can also directly affect the promotion of aquaculture (Ern, R. et al., 2014). An inappropriate salinity range will affect the physiology and biochemistry, immunity, growth and development, feeding, and reproduction of fish, and fish will show different adaptive states under various salinity conditions (Livingston, 2001). Recent studies have shown that salinity changes can cause physiological stress reactions in fish, accompanied by the production of excessive reactive oxygen free radicals, which can lead to oxidative stress reactions that damage the antioxidant defense system of fish (Wang, J.Q. et al., 1997). Excessive oxygen free radicals produced by oxidative stress will attack biological membranes, proteins, and nucleic acids, causing oxidative damage such as cytoplasmic efflux, enzyme inactivation, and genetic replication errors (Choi, C.Y. et al., 2008). As shown in the graph (graph 1.), increasing temperature gradually lower the dissolved oxygen and leads adverse effect on pond ecosystem which ultimately produce negative impact on fish growth and survival.

IV. CONCLUSION

Salinity has a significant influence on dissolved oxygen dynamics in pond ecosystems. Increasing salinity generally reduces oxygen solubility, thereby affecting fish growth, health, reproduction, and survival. The combined effects of salinity and oxygen stress can substantially reduce aquaculture productivity. Effective monitoring and management of both parameters are therefore essential for sustainable pisciculture. In many research, species-specific tolerance thresholds has also been identified which focus on adaptive management strategies under changing environmental conditions.

Table 1. Salinity and Dissolved Oxygen Data

Salinity (ppt)	Dissolved Oxygen (mg/L)
1 ± 0.3	8.5 ± 0.5
1 ± 0.3	8.1 ± 0.5
1.5 ± 0.3	7.7 ± 0.5
2 ± 0.3	7.2 ± 0.5
2 ± 0.3	6.8 ± 0.5
3 ± 0.3	6.3 ± 0.5
3.5 ± 0.3	5.9 ± 0.5
4 ± 0.3	5.8 ± 0.5

Fig.1. Relationship between Salinity and Dissolved Oxygen between Observation period - January - March , 2026.

(ppt- part per thousand equivalent to 1 g of solute per thousand g of water.)

Salinity vs Dissolved Oxygen Graph :

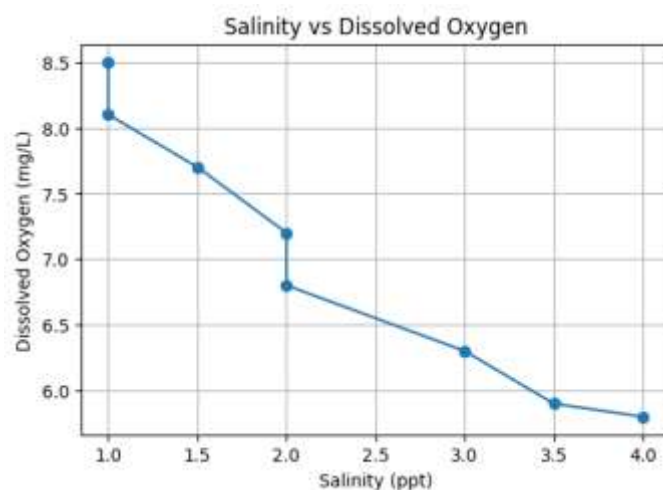


Fig.1 Relationship between salinity and dissolved oxygen in pond water. (Graph 1.)

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